REMARKS

Upon entry of the present amendment, claims 6, 10, 14 and 16-25 are pending in the application, of which claims 6, and 17 are independent. Claims 6, 17, 21 and 22 are amended herein and claims 23-25 have been added.

Examiner Interview

Applicant thanks the Examiner for the helpful and courteous telephonic interview that was conducted on October 17, 2008 with applicant's representative, Robert Petrik (33093). During the interview, applicant argued that the duration of the peening treatments according to the present invention are critical to achieving that claimed surface roughness and advantageously prolonged service life of a casting die according to the claimed invention, and are significantly and unobviously shorter than conventional peening times, such as the peening times disclosed in JP '845. The Examiner discussed his position that the applicant has not provided any evidence showing why it would not have been obvious to those of ordinary skill in the peening art to obtain the optimal peening times through routine experimentation, and that the need for evidence to show that the peening time is critical to overcome the obviousness rejection. A declaration under 37 CFR 1.132, such as filed together with the present Amendment, was discussed with the Examiner as such evidence. No agreement was reached.

Amendments Presented

Claims 6 and 17 have each been amended to correct an obvious error inadvertently introduced in Amendment-E, i.e., replacement of "16 mm" with --- 16 μm ---, and hence to be consistent with the specification disclosure and the arguments in Amendment-E which involve a surface roughness of 16 μm.

Claims 21, 22 have been amended to more particularly point out and distinctly claim the subject matter which applicant regards as the invention, and specifically to avoid an inaccurate interpretation of the claim language which has been applied to the JP '845 as discussed below, by changing the language "5-10 seconds/5 cm^{2}" to --- 5-10 seconds ---.

New claims 23 further defines that said steel material of claim 6 is an SCM chrome molybdenum steel material and after said second shot peening treatment said at least the cavity surface of said casting die has a hardness of at least 700 Vickers hardness, new claim 25 defines substantially the same limitations as claim 23 but depends from claim 17, and new claim 24 further defines that the sulphonitriding treatment step of claim 6 is performed in a processing chamber under controlled temperature in a range between 505 degrees Celsius and 580 degrees Celsius, similar to the limitation of claim 19.

Applicant respectfully submits that the added claim limitations are fully supported by the original disclosure, including: the abstract and paragraph [0037] of the published application which discuss a casting die formed of SCM 420 steel material having a Vickers hardness of at least 700; paragraph [0043] of the published application discussing a surface roughness of 16 μm after a first shot peening treatment according to the invention; and paragraphs [0047] and [0052] defining an exemplary embodiment of the invention. Applicant also respectfully submits that no new matter is introduced by the present amendment.

Response to Office Action

The above-identified Office Action has been reviewed, the references carefully considered, and the Examiner's comments carefully weighed. In view thereof, the present Amendment-G is respectfully submitted.

It is respectfully contended that by the present amendment, all bases of rejection set forth in the Office Action have been traversed and overcome. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

Finality of the Office Action

The Office Action was made final even though an RCE was filed together with the previously filed Amendment-F, and at item 6 of the Office Action the Examiner has asserted that "All claims are drawn to *the same invention* claimed in the application prior to entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and the art of record in the next Office Action if they had been entered in the application prior to entry under 37 CFR 1.114 (emphasis added)", as the basis for making the Office Action final.

Applicant respectfully traverses the Examiner's assertion and submits that the Office Action should not have been made final pursuant to the guidelines of MPEP 706.07(b) because the claims set forth in Amendment-F are not, in fact, drawn to the same invention given the limitations added to claims 1 and 17 in the Amendment-F, i.e., the limitations pertaining to the surface roughness and residual stress of the cavity surface after the each of the two peening steps. Such limitations are quite significant in showing / establishing the patentable distinctness of the claimed invention over the prior art, including JP '845, as discussed in Amendment-F and in the present Amendment-G. Moreover, the Examiner would not have entered the Amendment-F in the application unless the RCE had been filed due to the addition of the discussed limitations to claims 6, 17.

Correspondingly, applicant respectfully requests that the finality of the Office Action dated July 28, 2008 be reconsidered and withdrawn.

The Present Invention

The present invention relates to a casting die and a surface treatment for the die resulting from an important discovery made by the applicant in relation to the surface roughness of the used casting die when it is being treated to increase its residual stress. With the casting die of the present invention it is possible to advantageous decrease the frequency of replacement of the die in comparison to conventional casting dies subjected to conventional treatments, or in other words to give the die a longer service life as compared to conventional casting dies and conventional treatments for such dies, thereby reducing the production costs of products cast using the die. Also, the sulphonitriding diffusion layer can be easily formed on the cavity surface by the sulphonitriding treatment that is conducted after a first shot peening treatment and before a second shot peening treatment.

Claim Rejections – 35 USC § 103

At item 3 of the Office Action the Examiner has rejected claims 1-3, 6, 10, 17-19, 21 and 22 under 35 USC 103(a) as being unpatentable over JP '845 and further in view of JP '610 for substantially the same reasons as set forth in the prior Office Action relative to the prior rejection of claims 1-3, 6, 10, 17-19, and 21-22 , while at item 4 of the Office Action the Examiner has rejected claims 14, 16 and 20 under 35 USC 103(a) as being unpatentable over JP '845 and JP '610 as applied against claim 1 and further in view of Nakagawa et al. (US 6,546,968) for the same reasons as set forth in the prior Office Action relative to the rejection of claims 14, 16, 20. Particularly, the Examiner asserts that : the method of JP '845 substantially corresponds to the claimed invention, except that JP '845 does not disclose the surface roughness (maximum height) that is not more than 8μm and the use of a nitrosulphurizing process for coating the die surface; JP '610 discloses the use of a nitrosulphurizing process to form a coating layer on the die surface to prevent seizure in a die

by forming a dense coating layer having a lubricating effect and a thermal insulating effect which improves service life by forming a nitride layer containing iron sulfide on the die cavity surface, such that it would have been obvious to further include the iron sulfide of JP '610 with the nitride layer of JP '845; due to the similarities between the shot peening treatment of JP '845 and that of applicant's invention, it is expected that the surface roughness of JP '845 will be the same as that of the instant application; and that it would have been obvious to those of ordinary skill in the art to further modify the combination of JP '845 and JP '610 by suing hydrogen and ammonia gasses in the nitriding reaction based on the teachings of Nakagawa.

Furthermore, at item 5 of the Office Action, the Examiner provides the following rebuttal to the arguments presented in Amendment F:

a) regarding applicant's argument at the 2nd paragraph on page 8 that persons skilled in the art would not consider it obvious to apply the sulphonitriding treatment of JP '610 forging die to the casting die of JP '845, the Examiner refers to paragraph [005] of the present specification which states that it is conventional to use sulphonitriding treatment for the casting die.

b) Responding to applicant's argument that JP '845 does not disclose the claimed surface roughness of not more than 16 microns after a first peening step, and not more than 8 microns after the second peening step, the Examiner states that the process parameters set forth in paragraph [0025] of JP'845 and that of paragraphs [0047] and [0052] of the present specification, the parameters of the processes are in about the same range with respect to the diameter of the particle, injection pressure and injection time, whereas in JP '845 shot peening is conducted both before and after the nitriding step, like in the claimed invention, such that it is expected that deformation (and correspondingly the

surface roughness) of the die surface after the second peening step will be less than after the first peening step.

c) Responding to the applicant's argument that the peening time of the instant invention is not taught in the prior art, the Examiner cites paragraphs [0047] and [0052] of the present specification which indicates that peening lasts for 5-10 seconds/ cm^2 , whereas in paragraph [0023] and example 1 of JP'845 relates to a discoid with a diameter of 58 mm. The Examiner calculates that the peening time in JP'845 is 11 seconds/ cm^2 which the Examiner asserts is comparable to the range of 5-10 seconds/ cm^2 as claimed.

d) Responding to the applicant's argument that the residual stress even after the two shot peening treatments in JP '845 is less than 1000 MPa, contrary to the claimed stress of > 1200 MPa, the Examiner states that the residual stress would be dependent upon the type of material to be treated and the peening parameters. The Examiner further states that it would have been obvious to select a stronger material and appropriate processing parameters to obtain the desired residual stress results.

e) Responding to the applicant's argument that the reference to Nakagawa is non-analogous art, the Examiner states that Nakagawa discloses how the parameters of the process affect the nitriding process and that there is no reason why this concept should not apply in the nitriding process of JP '845.

Applicant's Response:

Upon careful consideration, and in light of the declaration of Hiroaki Koyama under 37 CFR 1.132 filed herewith, applicant traverses the Examiner's rejections of the present claims, and submits that each of the present claims is patentably distinct over the applied references whether considered singly or in combination, based on the following.

Initially, applicant respectfully submits that JP '845 does not, in fact, teach two shot peening steps / treatments lasting 5-10 seconds each, and which result respectively in a surface roughness of ≤ 16 μm and ≤ 8 μm, as well as a respective compressive residual stresses of $\geq$1000 MPa and $\geq$ 1200 MPa as defined in present claims 6, 17, contrary to the Examiner's asserted position / interpretation. Moreover, this distinction is very significant because it gives the casting die a longer service life as compared to conventional casting dies and conventional treatments for such dies, thereby reducing the production costs of products cast using the die. This distinction is understood from the declaration of Hiroaki Koyama under 37 CFR 1.132 and the following.

Shot Peening Time

The Examiner mentions that in JP '845 the total treatment time of 60 seconds is applied to the treated surface having a diameter of 58 mm, such that a total treated area of JP '845 is equal to 26.4 cm^2 . The Examiner then interprets a total peening treatment time of JP '845 to be about 11 seconds, which the Examiner asserts is about the same as applicant's claimed treatment time of 5-10 seconds. See the Examiner's rebuttal c) above. Applicant respectfully submits that the Examiner's interpretation is incorrect, and that the peening treatment time for the entire test piece in JP '845 is actually 60 seconds, consistent with conventional methods.

Generally, a conventional shot peening treatment is performed to an object or a test piece placed in a cavity of a shot peening apparatus, and balls/particles are shot against the entire surface of the object at a specific shot pressure for a predetermined time period. That is, in a general, conventional shot peening treatment, if the shot peening time is set to 60 seconds as in JP '845, shot balls /particles are shot against the entire surface of the object for the entire period of 60 seconds.

In the present invention, because the object is a casting die which is rather large in size, the inventors found that most shot peening apparatus are not large enough to accommodate the casting

die therein. Therefore, unlike in the conventional treatment procedure, it is difficult to secure a shot peening apparatus for carrying out the normal practice of concurrently shooting balls / particles over the entire surface of the object (casting die) for a given time period. Thus, the present inventors used a small, manually-operable shot peening nozzle for treating different portions of the casting die in sequential operations, i.e., the balls are shot from the nozzle toward one part of the casting die for the predetermined time of 5-10 seconds, then balls are shot from the nozzle toward another portion of the casting die for 5-10 seconds, and this is repeated until all portions of the casting die have been uniformly treated for 5-10 seconds.

In the actual, experimental procedures conducted by the inventors, the size of the treatment portion was $5cm^2$, and this is reflected by the discussion at paragraphs [0047] – [0052] of the published application, as well as in the language of claims 21-22 when these claims were originally introduced in Amendment-D. This recitation does not mean that any given shot peening time is merely divided by the surface area to be treated, as the Examiner has interpreted and applied relative to the disclosure of JP '845. Instead, the shot peening treatment time for the entire surface being treated is uniformly within the specified range of 5-10 seconds according to the present invention , whereas the language "/5 cm^2" merely reflects the particular, unusual condition which the inventors used for treating the large sized casting die because they did not have a treatment apparatus which could hold/enclose the die such that its entire surface could be concurrently subjected to the shot peening treatment for 5-10 seconds.

The above explanation is rational and would be considered as accurate by persons skilled in the art when the shot peening conditions are used to specify the surface roughness of the object. In contrast, if the Examiner's interpretation were considered to be correct, this would lead to absurd results. For example, if an object having an entire surface area of 5 cm^2 was subjected to the shot

peening treatment, the entire surface is hit by the balls uniformly for 5-10 seconds, whereas if an object having an entire surface area of 4 m^2 was subjected to such shot peening treatment, the entire surface area is hit by the balls uniformly for a day or a day and a half.

As understood from the foregoing, persons of ordinary skill in the art would understand / interpret the discussion of JP '845 regarding shot peening treatment time to mean that the average, uniform treatment time for the entire surface of the casting die is 60 seconds. Moreover, such persons would also understand that a treatment time of 60 seconds is in line with conventional practice, but is very much different than the claimed treatment time of 5-10 seconds for any given surface area.

Again, the language "/5 cm^2" has been deleted from claims 6, 17 to avoid the unintended confusion. Also, the above distinction is supported by the enclosed declaration of Hiroaki Koyama under 37 CFR 1.132, at paragraphs 5, 6, 10.

The Claimed Treatment Times Are Not Taught By or Obvious In View of JP '845

Again, applicant respectfully submits that the claimed peening treatments steps of 5-10 seconds which result respectively in a surface roughness of $\leq$ 16 μm and $\leq$ 8 μm, as well as a respective compressive residual stresses of $\geq$1000 MPa and $\geq$ 1200 MPa as defined in present claims 6, 17 are not taught or made obvious by the conventional treatment method disclosed in JP '845, and in fact result is a significant advantage - prolonged service life for the casting die, and corresponding cost reduction for parts cast using the die.

Differences between the claimed method steps (casting die) and those of JP '845 are discussed at paragraphs 6-10 of the declaration of Hiroaki Koyama under 37 CFR 1.132. As discussed, in the field of surface treatment, research is conducted to improve the useful life of metal products such as casting dies, and shows that shot peening prolongs the useful life. Therefore, shot

peening is widely used as the surface treatment for prolonging the service life of metal products. However, after a shot peening treatment a small surface roughness of not more than 8 μm would not be obtained according to the conventional treatment procedures, including that of JP '845. Rather, a surface roughness of significantly more than 8 μm has a conventionally recognized benefit. For a casting die, a surface roughness (maximum height) of approximately 50 μm is enough to obtain a better surface quality for a cast article. Therefore, those of ordinary skill in the art would try to make the surface roughness approximately 50 μm after the shot peening treatment, and would not try to achieve a surface roughness of a smaller value.

Also, as previously discussed in Amendment-D, it is not true or a matter of common knowledge that it is desirable to maintain the surface of a casting die as smooth as possible, whereas a surface roughness which is significantly larger than 8μm has a conventionally recognized benefit in relation to a casting die such as disclosed in JP '845. For a casting die, a surface roughness (maximum height) of approximately 50 μm is enough to "obtain a better surface quality for the cast article". In other words, if those of ordinary skill In the art intended to maintain a casting die surface as smooth as possible only in view of "improving a surface quality for the cast article", then such persons would try to make the surface roughness approximately 50 μm, and not to try any obtain a surface roughness of a smaller value.

Further, in a casting die, a molten metal flowing into the die has an oxide coating on its surface, and when the die has a surface roughness of approximately 50 μm, the oxide coating will be caught and broken by the die surface, so that a clean molten metal will flow in the die improving the heat conduction speed between the molten metal and the die. Persons skilled in the art would understand the foregoing, and would also understand that when the surface roughness is not more than 8 μm, the oxide coating of the molten metal will not be caught and broken by the die surface,

and the heat conduction might slightly become worse compared to a casting die with a normal surface roughness of approximately 50 μm.

Contrary to conventional wisdom, the present inventors found that the die cavity surface should be maintained as smooth as possible to increase a heat transfer rate between the cast metal and die surface, and also to obtain a better surface quality for the cast article. For this purpose, the inventors intentionally made the surface roughness not more than 8 μm and determined that they could do this by setting the shot peening time for a period in a range of 5-10 seconds in each of first and second shot peening treatments. Moreover, as discussed at paragraph 10 of the declaration, actual experiments conducted based on the claimed method involving shot peening treatments of 5-10 seconds and an injection pressure of 0.49 MPa and the method of JP '845 using shot peening treatments of 60 seconds and injection pressures of 0.3 MPa and 0.4 MPA, show that the resultant surface roughness of the claimed invention is 8 μm, whereas that of JP '845 is 61 μm.

Also, JP 845 shows a residual stress of less than 1000 MPa even after the two shot peening treatments. This is contrary to claims 6 and 17 which specifically set forth the residual stress is 1000 MPa or larger after the second peening step, contrary to claims 6, 17 which define a residual stress of at least 1200 MPa.

The Claimed Surface Roughness is not a Matter of Optimization

Applicant respectfully traverses the Examiner's assertion that the claimed surface roughness is an *obvious matter of optimization through routine experimentation* because *none of the applied references ever indicates that surface roughness is a result-oriented variable, which should be optimized*. MPEP 2144.05(B) states that "A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine

experimentation". *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). It is respectfully submitted that the art in this instance does not recognize the surface roughness as a result-effective variable. See also *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Here, conventional wisdom is that a surface roughness of approximately 50 μm is appropriate, whereas applicant has gone away from the conventional practice / wisdom by applying the shot-peening treatment for a reduced duration of 5-10 seconds. The claimed features are non-obvious as compared to conventional teachings, including JP '845, and provide an unexpected, useful result. Thus, the claimed features are unobvious because there is no showing that it would be a matter of routine experimentation to change from the conventionally desired range of approximately 50 μm (MPEP2144.05) in order to find something more optimal.

Rebuttal to the Examiner's Response

Relative to the Examiner's rebuttal b), applicant has shown that the process parameters of JP '845 are not, in fact, in the same ranges as the claimed process parameters, including a surface roughness of ≤ 16 μm after one peening step (which advantageously permits the sulphonitriding diffusion layer to be easily formed on the cavity surface), and a final surface roughness of ≤ 8 μm (which is contrary to a conventionally desirable surface roughness for casting dies). In this regard, the conventionally desirable surface roughness is a teaching away from the claimed invention, and hence an indication of non-obviousness as discussed above. Moreover, the references and other evidence of record do not otherwise establish surface roughness within the claimed ranges as a result-oriented variable to be optimized.

Relative to the Examiner's rebuttal d), there is no evidence of record or other proper support for the Examiner's allegation regarding selecting different materials and process parameters to obtain the claimed residual stress in the process of JP '845. In fact, JP '845 does not disclose the claimed residual stress and the Examiner's comments are nothing more than impermissible hindsight guided exclusively

from applicant's disclosure. Applicant has achieved a desirable/advantageous process for optimizing the useful life of a casting die which is not disclosed or suggested by the evidence of record.

In regard to claim 10 involving treatment of a used casting die, applicant respectfully traverses the rejection. Although JP '845 discloses a method for treating the surface of a new casting die involving shot peening, followed by nitriding treatment, followed by a second shot peening (see paragraph [0015]), in relation to treatment of a *used casting die*, JP '845 discloses a method including only a single shot peening step followed by a nitriding step (see paragraph [0015]) once the residual stress of the casting die surface has fallen below a predetermined value, e.g., 50% of the initial value, (see paragraphs [0016] – [0021]).

Based of the foregoing, applicant respectfully submits that the invention as defined by each of the present claims includes features which are neither disclosed nor suggested in any of the applied references JP'845, JP'610 and Nakagawa et al., considered either singly or in combination. Further, the claimed invention including these features obtains an excellent effect that cannot be expected from JP'845 and/or JP'610, i.e., significantly prolonged service life of the casting die. Therefore, the present invention is not obvious over the disclosures of JP'610, JP'845 and Nakagawa et al., considered either singly or in combination.

For all of the foregoing reasons, applicant requests reconsideration and withdrawal of the rejections of claims 6, 10, 14 and 16-22 under 35 USC §103(a).

Other Matters

New claims 23-25 are believed to be allowable based on the foregoing arguments regarding claims 6 and 17, as well as on the merits of the additional features recited in the new claims.

Conclusion

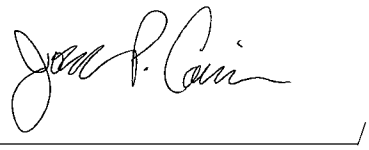
Based on all of the foregoing, applicant respectfully submits that all of the rejections set forth in the Office Action are overcome, and that all of the pending claims are believed to be

allowable over all of the references of record, whether considered singly or in any reasonable combination. It is applicant's contention that no possible reading of the references, either singly or in any reasonable combination, can be viewed as teaching applicant's claimed invention. For all of the above mentioned reasons, applicant requests reconsideration and withdrawal of the rejection of record, and allowance of each of the pending claims.

The application is now believed to be in condition for allowance, and a notice to this effect is earnestly solicited. If any issues remain unresolved, or if the Examiner feels that the prosecution of the present application could be expedited by a telephone discussion, applicant encourages the Examiner to telephonically contact applicant's undersigned representative to resolve any such issues remaining in the prosecution of the application.

Favorable consideration is respectfully requested.

Respectfully submitted,



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